

Claims:

1. Device for detecting an environmental influence (15) on a sensor (5), by means of detecting a change in an electrical conductivity of a sensor layer (3) of the sensor (5), whereby the sensor (5) has a first (7) and a second (9) excitation electrode, a piezoelectric material (11), and a sensor layer (3), which comprises: an excitation unit for generating electrical potentials (13), which are passed to the piezoelectric material by way of the first (7) and the second (9) excitation electrode, whereby the sensor layer (3) rests against both at least one excitation electrode and the piezoelectric material, at least in certain regions, and the sensor layer (3) has a conductivity that is dependent on environmental influences, so that the piezoelectric material can be excited to vibrate by means of the excitation electrodes and the sensor layer (3), characterized in that a frequency measurement device (17) makes it possible to detect a vibration order of the piezoelectric material.

2. Device according to claim 1, characterized in that the excitation unit (13) is formed by means of an oscillation circuit or a network analyzer.

3. Device according to one of the preceding claims, characterized in that the excitation electrode is formed from a metal, a non-oxide ceramic, oxide ceramic, or a precious metal.

4. Device according to one of the preceding claims, characterized in that the excitation electrode lies directly against the piezoelectric material.

5. Device according to one of the preceding claims, characterized in that the first excitation electrode (7) lies against the piezoelectric material with an area that is as large as an area with which the second excitation electrode (9) lies against the piezoelectric material.

6. Device according to one of the preceding claims, characterized in that the first excitation electrode (7) lies against the piezoelectric material with an area that is larger than or smaller than an area with which the second excitation electrode (9) lies against the piezoelectric material.

7. Device according to one of the preceding claims, characterized in that the excitation electrode(s) lie against the piezoelectric material with a circular area.

8. Device according to one of the preceding claims, characterized in that the first excitation electrode (7) has a same geometry as the second excitation electrode (9).
9. Device according to one of the preceding claims, characterized in that the piezoelectric material is formed from a quartz, from langasite, its isomorphous compounds, or from gallium orthophosphate, or is a piezoelectric material that is capable of functioning even at temperatures up to 1000°C.
10. Device according to one of the preceding claims, characterized in that the piezoelectric material has the basic shape of a cylinder.
11. Device according to one of the preceding claims, characterized in that the sensor layer (3) lies directly against the at least one excitation electrode and/or the piezoelectric material.
12. Device according to one of the preceding claims, characterized in that the sensor layer (3) is configured in circular shape.
13. Device according to one of the preceding claims, characterized in that the sensor layer (3) contains oxide

ceramics, non-oxide ceramics, semiconductors, organic synthetic or natural polymers, ZnO, ZnS, TiO₂, Se, CeO₂, oxides of transition metals, proteins or nucleic acids.

14. Device according to one of the preceding claims, characterized in that the frequency measurement device (17) comprises a frequency counter.

15. Device according to one of the preceding claims, characterized in that the vibration order is the first, third, fifth, or higher.

16. Method for detecting an environmental influence (15) on a sensor by means of detecting a change in the electrical conductivity of a sensor layer (3) of the sensor, using a device according to one of claims 1 to 15, which comprises the following steps:

1. Generating a fundamental tone in a piezoelectric material,
2. Measuring the resonance frequency of the vibration order of step 1,
3. Exerting an environmental influence (15) on the sensor layer (3), causing the conductivity of the sensor layer (3)

to be changed and thereby causing the frequency spectrum of the piezoelectric material to be changed,

4. Measuring the vibration order after exertion of the environmental influence,

5. Calculating a resonance frequency difference that is formed from the difference of the resonance frequency of the vibration order of step 1 and the resonance frequency of the vibration order after changing the environmental influence, and

6. Correlating the extent of the environmental influence (15) with the resonance frequency difference.

17. Method according to claim 16, characterized in that upper harmonics are also generated and measured in the piezoelectric material, which are also taken into consideration in detecting the type or the extent of the environmental influence (15).

18. Method according to one of claims 16 or 17, characterized in that the resonance frequencies of the upper harmonics serve for a temperature compensation of the vibration behavior of the piezoelectric material.

19. Method according to one of claims 16 to 18, characterized in that exerting an environmental influence (15) comprises irradiation of the sensor layer (3) with high-energy radiation.

20. Method according to one of claims 16 to 19, characterized in that the environmental influence (15) is the effect of a chemical or biological substance on the sensor layer (3), or a temperature change.

21. Method according to one of claims 16 to 20, characterized in that signals that run periodically, particularly rectangular, sine, or triangular signals, are passed to the piezoelectric material by the excitation unit (13).

22. Arrangement (23) of a first sensor (5o) and a second sensor (5u) for detecting an environmental influence (15), whereby the first sensor (5o) has a first (7) and an opposite second (9) excitation electrode, a piezoelectric material (11) disposed between these, and a sensor layer (3) that covers the first excitation electrode (7) and also the piezoelectric material (11) at least in certain regions, and the sensor layer (3) has a conductivity that is dependent on environmental influences (15), so that the piezoelectric material (11) can be excited to vibrate by means of electrical potentials from the excitation unit for generating electrical potentials (13), both by way of the excitation electrodes (7, 9) and by the sensor layer (3), and the resonance frequency of a vibration order of the piezoelectric

material (11) can be detected by means of a frequency measurement device (17), and

the second sensor (5u) has a first (7) and an opposite second (9) excitation electrode, a piezoelectric material (11) disposed between these, and a sensor layer (3) that covers the excitation electrode (9) at least in certain regions, but does not exceed it, and the sensor layer (3) has a conductivity that is dependent on environmental influences (15), whereby the sensor layer (3) is disposed in such a manner that the piezoelectric material (11) can be excited to vibrate exclusively by means of the excitation electrodes (7, 9), and the resonance frequency of a vibration order of the piezoelectric material can be detected by means of a frequency measurement device (17).

23. Arrangement according to claim 22, characterized in that the piezoelectric material (11) in the first sensor (5o) is identical with that of the second sensor (5u).

24. Arrangement according to claim 22 or 23, characterized in that the materials of which the excitation electrodes of the first and second sensor (5o, 5u) consist are identical.

25. Arrangement according to one of claims 22 to 24, characterized in that the material of which the sensor layer (3)

of the first sensor (5o) is formed is identical with the second material of which the sensor layer (3) of the second sensor (5u) is formed.

26. Arrangement according to one of claims 22 to 25, characterized in that the geometry in which the sensor layer (3) of the first sensor (5o) is shaped is identical with the geometry in which the sensor layer (3) of the second sensor (5u) is shaped.

27. Sensor device (25) for detecting an environmental influence (15), having a first (7) and a second (9) excitation electrode, a piezoelectric material (11) disposed between these, and a sensor layer (3), whereby the first excitation electrode (7) is disposed on a first side of the piezoelectric material (11), and the second excitation electrode (9) is disposed on the opposite, second side of the piezoelectric material, and the sensor layer (3) lies against the first excitation electrode (7) with a first partial area A1, and against the piezoelectric material (11) with a second partial area A2, and the sensor layer (3) has a conductivity that is dependent on environmental influences,

so that the piezoelectric material (11) can be excited to vibrate by means of electrical potentials from an excitation unit for generating electrical potentials (13), both by way of the

excitation electrodes (7, 9) and by the sensor layer (3), and the resonance frequency of a vibration order of the piezoelectric material (11) can be detected by means of a frequency measurement device (17), and

a third excitation electrode (27) is disposed on the second side of the piezoelectric material, which lies against the piezoelectric material (11) with an area A_3 , which is at least as large as the partial area A_2 of the sensor layer (3) and, if this partial area A_2 is projected onto the area A_3 , the partial area A_2 is completely covered by the area A_3 , and the first, second, and third excitation electrode are electrically connected with a switching means (29) that connects the second (9) and third (27) excitation electrode in electrically conductive manner in a first switching position, so that the conductivity of the sensor layer (3) can be detected, and the switching means (29) connects the first and third excitation electrode (27) in electrically conductive manner in a second switching position, so that the change in the vibration properties caused by deposit of substance of the environmental influence can be measured.

28. Sensor device according to claim 27, characterized in that the first excitation electrode (7) is formed in the shape of a circular disk on one side of the piezoelectric material.

29. Sensor device according to claim 27 or 28, characterized in that the second excitation electrode (9) is formed in the shape of a circular disk, and the third excitation electrode (27) is formed in the shape of a circular ring (31).

30. Sensor device according to claim 27, characterized in that the sensor layer (3) lies directly against the first excitation electrode and is circular.

31. Sensor device according to one of claims 27 to 30, characterized in that the piezoelectric material is formed in the shape of a cylinder (19), whereby the first, second, and third excitation electrode (27) as well as the piezoelectric material and the piezoelectric material have a common axis of symmetry.